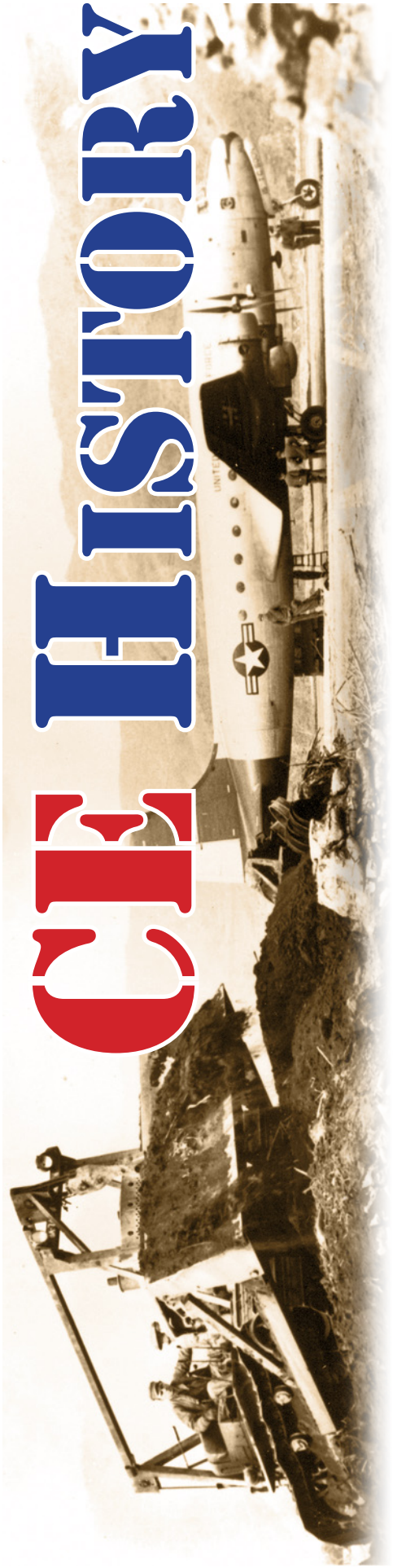

ENGINEERING AND SERVICES IN OPERATION DESERT SHIELD

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"Air bases are a determining factor in the success of air operations. The two-legged stool of men and planes would topple over without this equally important third leg."

~ General Henry H. "Hap" Arnold

In 1941, General Arnold recognized the importance of the air base and air power's reliance on it.[1] In 1990, the Air Force reaffirmed this premise when it deployed aircraft and personnel halfway around the world in support of Operation Desert Shield. Engineering and Services were two of the combat support elements deployed to the Middle East to support the deploying aircraft. Both played a critical role in preparing and sustaining air bases and supporting their personnel.

Air Force Engineering and Services is responsible for myriad base support functions. Everything from force beddown, fire protection, food service, laundry, and mortuary affairs fell under the purview of Engineering and Services. Engineering responds to contingency and wartime situations through their Prime Base Engineer Emergency Force (BEEF) and Civil Engineering RED HORSE units, a heavy repair and construction force. The Air Force established these programs during the early days of the Vietnam War to provide wartime engineering support. In 1978, just three years after Engineering and Services merged, the Prime Readiness In Base Services (RIBS) program was created. This was patterned after the Prime BEEF concept of mobile teams ready to respond worldwide to contingency and wartime situations.[2]

On August 2, 1990, when Iraq invaded Kuwait, the Air Force made plans to deploy a show of force to the region to prevent an invasion of Saudi Arabia. Immediately the search for adequate beddown locations was begun. Fortunately, the Kingdom of Saudi Arabia possessed basing facilities ready to meet the coalition team's massive requirements. This was a result of remarkable foresight, extensive planning, and close cooperation between the United States Air Force and the Royal Saudi Air Force. As early as 1974, a DOD survey, developed at the request of the Saudi Arabian government, recommended a phased modernization and industrialization program. Included with various weapons systems agreements was an extensive air base planning and facility construction program. Three major bases evolved from this program—Dhahran, Taif, and Khamis Mushait. Through the various Peace programs (Hawk, Sun, Sentinel, and Shield), the Saudi Arabian government had state-of-the-art facilities available for coalition forces.[3] The senior Air Force Engineering and Services representative on the United States Central Command-Air Forces' staff, Colonel Karsten H. Rothenberg (USCENTAF/DE), was the Director of Air Force Foreign Military Sales Construction Engineers, Headquarters Air Force Logistics Command, the office responsible for the Saudi Arabian air base construction programs.

(Printed in Air Power History, Fall 1991)

In a perfect world, civil engineers and services personnel are among the first to deploy to a new operating location. They can then construct the beddown facilities, establish utility capabilities, and prepare food service operations to "catch" the aircraft and the support personnel. However, in the real world, it rarely happens this way. When Operation Desert Shield began on 7 August 1990, the initial Coronet Lightning package of aircraft deployed to a handful of bases, with little or no Air Force Engineering and Services capabilities available. At Al Dhafra, United Arab Emirates, pilots had only Meals Ready to Eat (MREs) and slept under a wing of their aircraft. Engineering and Services personnel had to play catch-up at nearly all bases in the early days of Operation Desert Shield.

Engineers construct a TEMPER Tent at an Desert Shield location.

When the civil engineers did arrive at a site, their first requirement was usually to begin the base layout to include tent city, maintenance facilities, and other offices and shops. Because many engineers had little advance information about their deployment location until they actually arrived on site, there was little opportunity to plan for the siting of the various working and living areas. At a few sites the base layout was severely limited by the available space, the whim of the base commander, or even the discretion of the local member of the royal family. This was particularly evident at bases such as Riyadh Air Base, which was occupied by a host nation air force. Air Force personnel had to work around existing structures and establish living and working areas wherever possible. This was not always at the most convenient or logical locations, but Air Force personnel made the best of often difficult situations.

Engineering and Services personnel used Harvest Falcon assets to beddown deploying forces. Created in the 1980s, Harvest Falcon is a complete bare base set that provides both housekeeping and aircraft maintenance facilities. It combines aspects of Harvest Eagle and Harvest Bare and uses soft-wall, and some hard-wall, shelters for base support and hard-wall shelters for aircraft support. All Harvest Falcon equipment is designed specifically for Southwest Asia (SWA) operations (no freeze protection). The most common personnel shelter is the Tent, Extendable, Modular, PERsonnel (TEMPER) tents. These soft-wall structures are modular, frame-supported tents that can be assembled without tools. Each section is 20 feet wide and 8 feet long. A crew of four can assemble two TEMPER sections in 30 minutes. TEMPER tents include lighting, liners, insulated floors, and an air conditioning distribution system. Most billeting tents comprise four TEMPER tent sections. Environmental Control Units provide the cooling required by many aircraft support activities and comfortable living space for billets and dining facilities.

The Harvest Falcon equipment arrived at Desert Shield bases in Brooks and Perkins boxes from prepositioning sites in the region. But the assets were being sent by logistics personnel and with little engineering input. This resulted in various parts required for the construction of a tent city arriving at different times and not necessarily in the proper order. "It takes several components to make a system work, and without all of the equipment, the whole

Engineers lay out camouflage netting.

system doesn't work," was the observation of an engineer at one site.[4]

If existing billeting was unavailable, and it usually was not, everyone, not only civil engineers, went to work setting up "Tent City." It is always interesting to see what brings people together. Sleeping on hangar floors, in abandoned caravans, or in crowded hallways did just that. Almost everyone pitched in to help set up tents. Although some Air Force personnel initially were housed in hotels downtown, the terrorism threat forced them on base. Soon rows and rows of tents blossomed on the Saudi sand. Engineers erected approximately 5,000 tents during Operation Desert Shield. Many of the bases gave their tent city names such as "Camellot" [sic] and "Bedrock City."

Obtaining heavy construction equipment was a problem at many sites. Engineers often resorted to borrowing or renting from host nation engineers and heavy construction companies. The initial requirement was to grade areas for tent construction and carve out roads between the base's primary living and working areas. After a few weeks, heavy equipment operators transitioned to projects such as berms for munitions storage areas and defensive positions, pads for facilities, and aircraft parking areas. Operators also paved miles of road, hardstands, parking areas, and common-use areas.

Engineers were more productive working at night than working during the heat of the day.

The harsh environment created numerous problems for engineering personnel. They found it nearly impossible to do heavy work during the day. At Al Dhafra, two shifts were established, one beginning at 1800 and the other at about 2400. This permitted the troops to be as productive as possible, still get their rest, and avoid the midday heat which often reached 120 F.

Electricity was critical to Air Force operations. A few sites had adequate commercial power available and only required connecting to the source. At most sites, generators had to be brought in to provide adequate electrical power. Initially, small 60- or 100-kilowatt (KW) Mobile Electric Power (MEP) emergency generators were used to power tent cities, aircraft maintenance shops, and logistical areas. Not only were these generators prone to failure from continuous use in a harsh environment, but the roar was almost deafening to the tent occupants. The growing numbers of personnel and aircraft in-theater during August and September overwhelmed these small generators. Civil engineering laid underground high-voltage cables and brought in more efficient MEP-12 750KW generators. Power production personnel were kept busy around the clock monitoring, maintaining, and repairing these critical assets. Because the generators worked continuously in oppressive heat and dusty conditions, they should have been taken off-line and maintained every 300 hours. This was not always possible because in the initial weeks and months of Operation Desert Shield, spare parts were not available. The War Readiness Spares Kits that were supposed to accompany the generators often did not. Power production personnel had to run generators far beyond the normal maintenance schedule, and if one broke down irreparably, it was cannibalized to supply parts for the other generators.

Heavy construction equipment was in demand throughout the theater.

Nearly all of the sites faced problems in distributing power to the end user. Tents and other equipment required 120 volt power, so special step-down equipment such as the Contactor Control Cubicle (CCC) had to be used. Operation Desert Shield caught the Air Force in

the midst of a transition from the CCC to the Primary Distribution Center (PDC) because of problems in operating a CCC in a desert environment. Only three PDCs were available in SWA, and the likelihood of meeting the power requirements at a growing number of sites was problematic. USCENTAF/DE provided a requirement for additional PDCs and Civil Engineering Maintenance, Inspection, Repair, and Training (CEMIRT) teams went to work.[5] In just a matter of days, CEMIRT technicians designed a simple and reliable PDC using off-the-shelf components. They began constructing the new PDCs at Kelly AFB, Texas, at the rate of better than one per day. By 26 September, CEMIRT had constructed and shipped 35 PDCs to Desert Shield sites, enabling Air Force technicians to provide critical power to the bases.[6] CEMIRT personnel also deployed to the Middle East to provide critical depot-level generator maintenance.

Another critical issue faced by engineers in the early days of the deployment was water—how to obtain it, purify it, store it, distribute it, and dispose of it. Primary water users at the sites were kitchens, latrines, showers, laundry, hospitals, and for drinking. As with electrical power, some sites had existing water distribution systems that could be used. But nearly every site had to augment the in-place system. Water was supplied either through existing systems, wells, or desalinization plants. The Harvest Falcon water distribution system uses uninsulated plastic pipe. At many sites, the water had to be trucked in and stored in 4,750 or 10,000 gallon rubber bladders. The quality of water varied from site to site. A few sites only needed to add a small amount of chemicals to bring it up to standards. Others were required to process it through the Reverse Osmosis Water Purification Unit.[7] Bottled drinking water was available at all sites. Wastewater was distributed either to underground storage tanks and pumped out by contractors or to a gray water pond for evaporation or absorption. However, soil conditions at some sites were a clay/sandy soil with a hard sandstone subbase that did not permit absorption, and high humidity slowed evaporation. Engineers constructed lagoon systems to pipe the gray water further from the cantonment area and reduce the potential health hazard.[8]

Engineers' accomplishments the first days and weeks of the deployment were noteworthy. The following is a summary of a Prime BEEF team's first month's work at King Fahd International Airport, Saudi Arabia:

> The group accomplishments include laying over 4,000 tons of asphalt for roads, parking, ATH [Air Transportable Hospital], Helo pads and chow halls. We erected over 370 tents, set up 6 shower units, 10 latrines, a camp potable water and electric distribution system, a camp revetment system, designed and installed a bunker system, provided wood floors for admin/shop tents, constructed a mall complex consisting of a chapel, BX, movie tents, recreation center, laundry, and personnel facility. We have sectionalized the base for bomb damage repair purposes and set in place the teams to conduct those operations. We set up our own logistics operation to acquire material and tools we could not obtain elsewhere for which we continue to rely on for 100 percent of our support.[9]

Air Force firefighters on duty with an F-16.

Firefighters, part of Air Force Civil Engineering since 1947, provided crash/fire rescue service to all Air Force sites in the

region. They often integrated with host nation firefighters, sharing equipment and working areas. In-flight and ground emergencies, including hot-brake responses, kept Air Force firefighters busy. Many patrol and training sorties during Operation Desert Shield involved hot refueling standbys for firefighters. During the war, demands on the firefighters increased. See table for fire department responses between 1 January and 28 February 1991 at King Khalid Military City, Saudi Arabia:[10]

Activity/Response	Number	Manhours
In-flight Emergency	157	418.0
Ground Emergency	31	47.5
Crash Landing	5	70.5
Fire Emergency	3	8.0
Medical Emergency	7	7.5
AirEvac Standby	50	114.0
Integrated Combat Turn Standby	785	3374.0
Fuel Spill	9	13.0
Green Engine Run	9	12.0
Aircraft Arresting Barrier Activity	20	56.0
Total	**1076**	**4120.5**

Air Force Services personnel also had their hands full during the first weeks and months of the deployment. They were responsible for functions such as food service, laundry, billeting, and mortuary services. None was more critical than food service.

Air Force personnel deploying to Operation Desert Shield were required to take at least two days of MREs to sustain themselves during the initial deployment. This was critical at several locations because MREs were the only food available for the first few days and weeks. Other sites had contract meal service available at local hotels or on-base facilities almost from the beginning. But as the terrorist threat forced people on base, this availability was reduced. Several sites had fixed dining facilities operated by contractors for either the military or contractor personnel working at that specific site. Services personnel often augmented these operations.

At most sites, Prime RIBS personnel prepared and served meals in a Harvest Falcon kitchen, commonly known as a 9-1 kitchen. Using specially-designed TEMPER tents, these kitchens provided an air-conditioned dining area, food preparation area, and storage space. Each kitchen was designed to support 1,100 personnel, although at several locations it served many more.

Air Force personnel ate three principal types of rations during Operations Desert Shield/Desert Storm: A-rations, B-rations, and MREs. A-rations consist of perishables; e.g. lettuce, fresh milk, fruit, etc. B-rations are nonperishables, such as canned meats, packaged foods, and other containerized foods which may be stored and remain edible for long periods of time. MREs are combat rations prepackaged in lightweight plastic pouches. Procuring rations was a difficult task for Services personnel. A large number of MREs were immediately available from prepositioned assets. Air and sea shipments of B-rations began within 10 days of the initial deployment. A-rations were available at varying times depending on the proximity of host nation grocery stores or food service operations. The Air Force Commissary Service Prime FARE (Food and Readiness) teams set up a central distribution center for ration storage and breakdown in-theater. However, many sites were on their own to procure rations from local suppliers. At nearly all sites, Air Force personnel were eating at least one hot meal a day within two weeks of arrival.

Billeting personnel faced the challenge of finding sufficient living and sleeping quarters for an unknown and ever-increasing number of Air Force personnel coming into the theater. Billeting personnel often did not know who was coming until someone showed up on the doorstep looking for a place to sleep. All available facilities were used during the first few weeks. School dormitories, hotels, vacant housing projects, contractor housing compounds, and youth sports complexes were all used at various times. Most Air Force personnel simply lived in a tent city on base. Services personnel maintained housing records on personnel

billeted on and off base. Linen exchange became an important function after a few weeks. Sheets and blankets were exchanged and cleaned on a one-for-one basis.

At deployed locations, kitchens and hospitals always have heavy laundry requirements to maintain sanitary conditions. During Operation Desert Shield, laundry service became critical because of the chemical and biological threat posed by Iraq. The Air Force used contractor laundry service whenever possible. At sites where this was not available, the tactical field laundry was used, but suffered from poor reliability.[11] As a result, seven new self-help laundry systems, using industrial-type washers and home-style dryers, were fielded and tested during the operation with good response from the users. Some locations simply went out and purchased laundromat-type washers and dryers (but without the coin slots) for both personal and organizational laundry.

Prime RIBS personnel were also responsible for mortuary services during Operation Desert Shield. Each base had a mini-morgue kit to process remains which were then sent to Dhahran Air Base, Saudi Arabia. There a Prime RIBS team from the Air Force Engineering and Services Center, Tyndall Air Force Base, Florida, was responsible for the identification (when possible), processing, and coordination of the movement of remains to the Port Mortuary at Dover AFB, Delaware. Operation Desert Shield presented a challenge to mortuary personnel. The possibility of contaminated remains from a biological or chemical attack required special handling procedures and precautions to prevent further exposure. Host nation restrictions regarding non-Moslem burials also complicated matters. Inter-service relationships were confusing and oftentimes strained as the personnel attempted to coordinate varying methods of handling remains. But in every case, remains were processed and returned to the United States as quickly as possible and with the utmost respect and dignity.[12]

Because of the large number of contractor personnel employed in Services functions, proper supervision was vital. Varying sanitary and cultural standards in food preparation between contractor and American personnel led to constant monitoring to avoid potentially dangerous health hazards. The supervisors also served as quality monitors on contractor service. Great concern developed over the reliability of contractor personnel during the impending conflict. Contingency plans were developed to replace contracted services if contractor personnel did not report for work. Many of these concerns were justified. But after just a few days, most contractor personnel returned to their jobs.

By November, most Air Force sites were operating smoothly. Engineering personnel transitioned from beddown to the traditional base operations and maintenance activities. They began constructing quality-of-life facilities to boost morale and give the sites a little touch of home. Recreational facilities, pavilions, and theaters were common at most sites. Self-help shops assisted nonengineers in making improvements to their living quarters. Services personnel had settled into a routine of serving at least two hot meals a day and were making preparations for a traditional Thanksgiving meal.

When President George Bush announced an additional buildup of forces in November, Air Force Engineering and Services personnel once again prepared to support deploying aircraft and personnel in the theater. This time beddown was different, however. Engineering and Services personnel would be in place *before* the aircraft arrived. Another difference was the presence of RED HORSE, a heavy construction force to assist in the initial beddown of forces. Existing bases prepared for additional aircraft and new sites were chosen to base the Phase II aircraft and personnel.

An Expandable Personnel Shelter ready for assembly.

One of the new sites, Al Kharj, 60 miles south of Riyadh, was a classic bare base operation—just a runway, parking area, and taxiways. Water would have to be trucked in from an off-site water plant 12 miles away. On 11 November, RED HORSE personnel and Pope Air Force Base engineers already at Thumrait Air Base, Oman, were notified to prepare to move to the new base and bed-down a significant number of F-15 and F-16 aircraft. A few weeks later when the aircraft arrived, the base was ready: munitions storage areas had been built, fuel bladder berms constructed, water and power distribution systems completed, mobile aircraft arresting barriers installed, and over 600 tents and other structures erected.

Engineering and Services personnel were prepared for the 15 January deadline. For engineering personnel at forward bases, this meant constructing aircraft revetments, accumulating rapid runway repair assets, building personnel and equipment protective structures, and training for base recovery after attack in a chemical environment. Services personnel worked the final pre-war weeks ensuring mortuary supplies were adequate and establishing contingency plans in case contractor personnel did not report for work. Engineering and Services personnel had set the stage for Operation Desert Storm by providing the basing and support to permit the pilots to fly, fight, and win.

Operations Desert Shield and Desert Storm have shown once again that air base availability and performance are critical factors in a commander's ability to employ aerospace power. Engineering and Services personnel play an essential role in developing and maintaining effective air base performance. Air Force Civil Engineering Combat Support Doctrine states,

> The network of bases required to project aerospace power has been historically a critical element of the commander's operational strategy. A commander's exercise of operational art has always involved choosing when and where to fight, creating conditions that gave his or her forces the best chance of winning, and exploiting opportunities that resulted.[13]

With all of the recent advancements in aerospace power, without Engineering and Services personnel to provide and sustain the air base, the airpower stool will fall over.

ENDNOTES

[1] Maj Gen Henry H. Arnold, "The Air Forces and Military Engineers," *Military Engineer*, December 1941, p. 4.

[2] Lt Col William T. Meredith, "Project Prime BEEF," *Air Force Civil Engineer*, (November 1964) pp. 2-5; "Project Prime BEEF: Civil Engineering Manpower and Career Development Study", 1964; "Project RED HORSE," *Air Force Civil Engineer*, (May 1966) pp. 2-4; Maj Max Day and Lt Col George T. Murphy, "The Wartime Role of Engineering and Services," *Engineering and Services Quarterly*, (August 1980) pp. 13-15.

[3] Lt Col Harry W. Glaze and Lt Col Larry G. Garrison, "The Saudi Arabian Construction Program," *Engineering and Services Quarterly*, May 1980, pp 20-23.

[4] SSgt Detroit Whiteside, "Others Promise, They Produce," *E&S Update*, November 1990, p. 1.

[5] CEMIRT personnel from five regional locations perform depot-level maintenance, inspection, repair, and overhaul of power-generating equipment, heating, ventilating and air conditioning control systems, and intrusion detection alarm systems worldwide.

[6] "Center's Support to Desert Shield/Storm Outlined," *E&S Update*, May-June 1991, p. 2.

[7] The Reverse Osmosis Water Purification Unit is a mobile water purification unit used to

supply drinking water for personnel in the field. The unit will produce potable water from either seawater or freshwater at the rate of 10 gallons per minute.

[8] Unit History, 363d Civil Engineering Squadron (Deployed), 10 September to 10 October 1990.

[9] Unit History, 354th Civil Engineering Squadron (Deployed), 17 August to 22 September 1990.

[10] Unit History, Fire Department, King Khalid Military City, 1 March 1991.

[11] The tactical field laundry is designed to process 120 pounds of laundry per hour 20 hours per day. The system uses commercial and military components. The washer and extractor are commercial units. The dryer, water heater and pump are standard military issue. The unit is usually operated by two persons.

[12] Unit History, USCENTAF Mortuary Assistance Team, 7 August 1990 to 6 September 1990.

[13] Air Force Manual 3-2, *Civil Engineering Combat Support Doctrine*, 26 April 1991, p. 5.